

In the Claims

1 (currently amended). A capillary column comprising:

a tube structure including an inner surface; and

a sol-gel substrate bonded to ~~a non-branching sol-gel active portion~~ a core of a dendrimer substrate to form a sol-gel dendrimer matrix, wherein said sol-gel dendrimer matrix ~~bonds~~ is covalently bonded to a portion of said inner surface of said tube structure to form a surface-bonded stationary phase coating thereon, wherein said dendrimer is made from monomers selected from the group consisting of isocyanates, isocyanates with benzyl ether terminal groups, t-butyl isocyanate monomers, and bis-homotris compounds, 4-amino-4-[1-(3-hydroxypropyl)]-1,7-heptanediol, 4-[1-(3-aminopropyl)]-4-[1-(3-hydroxypropyl)]-1,7-heptanediol, aminotriols, quaternary nitroalkanes, and other cascade monomers.

2 (original). The capillary column according to claim 1, wherein said sol-gel substrate is made from sol-gel precursors having the general structure:



wherein,

Z = a precursor-forming element selected from the group consisting of silicon, aluminum, titanium, zirconium, vanadium, and germanium; and

R₁, R₂, R₃, and R₄ = R-groups are moieties selected from the group consisting of sol-gel-active moieties, alkoxy moieties, hydroxy moieties, non-sol-gel-active methyl, octadecyl, and phenyl.

3 (original). The capillary column according to claim 2, wherein said alkoxy groups are selected from the group consisting of a methoxy group, ethoxy group, n-Propoxy group, iso-Propoxy group, n-butoxy group, iso-butoxy group, and tert-butoxy group.

4 (original). The capillary column according to claim 2, wherein one to two said R-groups are moieties selected from the group consisting of alkyl moieties and their derivatives, alkenyl moieties and their derivative, aryl moieties and their derivatives, arylene moieties and their derivatives, cyanoalkyl moieties and their derivatives, fluoroalkyl moieties and their derivatives, phenyl moieties and their derivatives, cyanophenyl moieties and their derivatives, biphenyl moiety and its derivatives, cyanobiphenyl moieties and their derivatives, dicyanobiphenyl moieties and their derivatives, cyclodextrin moieties and their derivatives, crown ether moieties and their derivatives, cryptand moieties and their derivatives, calixarene moieties and their derivatives, liquid crystal moieties and their derivatives, dendrimer moieties and their derivatives, cyclophane moieties and their derivatives, chiral moieties, and polymeric moieties.

5 (withdrawn). The capillary column according to claim 4, wherein two to three said R-groups are moieties selected from the group consisting of methyl, octadecyl, phenyl, and hydrogen.

6 (cancelled)

7 (currently amended). The capillary column according to ~~claim 6~~ claim 1, wherein said isocyanates are of the formula $O=C=N-C(CH_2-R)_3$, wherein R is selected from the group consisting of:

- a) $-CH_2-tbu$;
- b) $-(CH_2)_n-CH_2-COOR'$;
- c) $-O-(CH_2)_n-CH_2COOR'$;
- d) $-O-(CH_2)_n-CH_2-CN$; and
- e) $-(CH_2)_n-CH_2-O-R''$;

R' being selected from the group consisting of alkyl (C-1 to C-20), cycloalkyl (C-3 to C-10), aryl, heteroaryl, polycycloalkyl, and adamantyl; and

R'' being selected from the group consisting of alkyl, cycloalkyl, aryl, $-CO-R'''$, $-CS-R'''$, $-SO_2-R'''$, $-SiR'''_3$, $-(CH_2)_n-CH_2-CN$, and $-(CH_2)_n-CH_2-COOR'''$;

wherein R''' is alkyl (C-1 to C-20), cycloalkyl (C-3 to C-10), aryl, heteroaryl, polycycloalkyl, adamantyl, n= 0-10 in all formulas.

8 (original). The capillary column according to claim 1, wherein said sol-gel substrate further includes a residual of a deactivation reagent selected from the group consisting of polymethylhydrosiloxane, hexamethyldisilazane, 1,1,1,3,3,3-hexamethyldisilazane, hydrosiloxane, and hydrosilane.

9 (original). The capillary column according to claim 1, wherein said sol-gel substrate further includes at least one baseline stabilizing reagent residual selected from the group consisting of residuals from bis(trimethoxysilylethyl)-benzene, sol-gel active reagents with phenyl-containing groups, and cyclohexane-containing groups.

10 (original). The capillary column according to claim 1, wherein said tube structure is made of materials selected from the group consisting of glass, fused silica, alumina, titania, and zirconia.

11-17 (cancelled)

18 (currently amended). A gas chromatography column comprising:

a capillary column including a tube structure having an inner surface; and

a sol-gel substrate bonded to a non-branching sol-gel active portion-core of a dendrimer moiety to form a sol-gel dendrimer matrix, wherein said sol-gel dendrimer matrix bonds is covalently bonded to a portion of said inner surface of said tube structure to form a surface-bonded stationary phase coating thereon, wherein said dendrimer is made from monomers selected from the group consisting of isocyanates, isocyanates with benzyl ether terminal groups, t-butyl isocyanate monomers, and bis-homotris compounds, 4-amino-4-[1-(3-hydroxypropyl)]-1,7-heptanediol, 4-[1-(3-aminopropyl)]-4-[1-(3-hydroxypropyl)]-1,7-heptanediol, aminotriols, quaternary nitroalkanes, and other cascade monomers.

19 (currently amended). A capillary column comprising:

a tube structure including an inner surface;

a stationary phase coating attached to at least a portion of said inner surface; and

a dendrimer moiety chemically bonded to said stationary phase coating for selectively interacting with various analytes, wherein ~~said a~~ sol-gel substrate is bonded to a ~~non-branching sol-gel-active-arm-core~~ of said dendrimer moiety, wherein said dendrimer is made from monomers selected from the group consisting of isocyanates, isocyanates with benzyl ether terminal groups, t-butyl isocyanate monomers, and bis-homotriss compounds, 4-amino-4-[1-(3-hydroxypropyl)]-1,7-heptanediol, 4-[1-(3-aminopropyl)]-4-[1-(3-hydroxypropyl)]-1, 7-heptanediol, aminotriols, quaternary nitroalkanes, and other cascade monomers.

20 (original). The capillary column according to claim 19, wherein said stationary phase coating includes a sol-gel substrate made from sol-gel precursors having the general structure:



wherein,

Z = a precursor-forming element selected from the group consisting of silicon, aluminum, titanium, zirconium, vanadium, and germanium; and

R₁, R₂, R₃, and R₄ = R-groups are moieties selected from the group consisting of sol-gel-active moieties, alkoxy moieties, hydroxy moieties, non-sol-gel-active methyl, octadecyl, and phenyl.

21 (original). The capillary column according to claim 20, wherein said alkoxy groups are selected from the group consisting of a methoxy group, ethoxy group, n-Propoxy group, iso-Propoxy group, n-butoxy group, iso-butoxy group, and tert-butoxy group.

22 (withdrawn). The capillary column according to claim 20, wherein said R-groups are at least two moieties selected from the group consisting of alkyl moieties and their derivatives, alkenyl moieties and their derivatives, aryl moieties and their derivatives, arylene moieties and their derivatives, cyanoalkyl moieties and their derivatives, fluoroalkyl moieties and their derivatives, phenyl moieties and their derivatives, cyanophenyl moieties and their derivatives, biphenyl moiety and its derivatives, cyanobiphenyl moieties and their derivatives, dicyanobiphenyl moieties and their derivatives, cyclodextrin moieties and their derivatives, crown ether moieties and their derivatives, cryptand moieties and their derivatives, calixarene moieties and their derivatives, liquid crystal moieties and their derivatives, dendrimer moieties and their derivatives, cyclophane moieties and their derivatives, chiral moieties, and polymeric moieties.

23 (withdrawn). The capillary column according to claim 22, wherein remaining said R-groups are moieties selected from the group consisting of methyl, octadecyl, phenyl, and hydrogen.

24 (cancelled)

25 (currently amended). The capillary column according to ~~claim 24~~ claim 19, wherein said isocyanates are of the formula of $O=C=N-C(CH_2-R)_3$, wherein R is selected from the group consisting of:

- a) $-CH_2-tbu$;
- b) $-(CH_2)_n-CH_2-COOR'$;
- c) $-O-(CH_2)_n-CH_2COOR'$;
- d) $-O-(CH_2)_n-CH_2-CN$; and
- e) $-(CH_2)_n-CH_2-O-R''$;

R' being selected from the group consisting of alkyl (C-1 to C-20), cycloalkyl (C-3 to C-10), aryl, heteroaryl, polycycloalkyl, and adamantyl; and

R'' being selected from the group consisting of alkyl, cycloalkyl, aryl, $-CO-R'''$, $-CS-R'''$, $-SO_2-R'''$, $-SiR'''_3$, $-(CH_2)_n-CH_2-CN$, and $-(CH_2)_n-CH_2-COOR'''$;

wherein R''' is alkyl (C-1 to C-20), cycloalkyl (C-3 to C-10), aryl, heteroaryl, polycycloalkyl, adamantyl, n= 0-10 in all formulas.

26-27 (cancelled)

28 (currently amended). A separation and extraction apparatus comprising a stationary phase of a sol-gel bonded to a ~~non-branching sol-gel active portion-core~~ of a dendrimer moiety, wherein said stationary phase is covalently bonded to a surface, wherein said dendrimer is made from monomers selected from the group consisting of isocyanates, isocyanates with benzyl ether terminal groups, t-butyl isocyanate monomers, and bis-homotris compounds, 4-amino-4-[1-(3-hydroxypropyl)]-1,7-heptanediol, 4-[1-(3-aminopropyl)]-4-[1-(3-hydroxypropyl)]-1,7-heptanediol, aminotriols, quaternary nitroalkanes, and other cascade monomers.

29 (currently amended). A separation and extraction phase comprising a sol-gel bonded to a ~~non-branching sol-gel active portion-core~~ of a dendrimer moiety, wherein said dendrimer is made from monomers selected from the group consisting of isocyanates, isocyanates with benzyl ether terminal groups, t-butyl isocyanate monomers, and bis-homotris compounds, 4-amino-4-[1-(3-hydroxypropyl)]-1,7-heptanediol, 4-[1-(3-aminopropyl)]-4-[1-(3-hydroxypropyl)]-1,7-heptanediol, aminotriols, quaternary nitroalkanes, and other cascade monomers.

30-34 (cancelled)

35 (previously presented): The capillary column according to claim 2, wherein said alkoxy groups are selected from the group consisting of a methoxy group, ethoxy group, n-Propoxy group, iso-Propoxy group, n-butoxy group, iso-butoxy group, and tert-butoxy group, and wherein one to two said R-groups are moieties selected from the group consisting of alkyl moieties and their derivatives, alkenyl moieties and their derivative, aryl moieties and their derivatives, arylene moieties and their derivatives, cyanoalkyl moieties and their derivatives, fluoroalkyl moieties and their derivatives, phenyl moieties and their derivatives, cyanophenyl moieties and their derivatives, biphenyl moiety

and its derivatives, cyanobiphenyl moieties and their derivatives, dicyanobiphenyl moieties and their derivatives, cyclodextrin moieties and their derivatives, crown ether moieties and their derivatives, cryptand moieties and their derivatives, calixarene moieties and their derivatives, liquid crystal moieties and their derivatives, dendrimer moieties and their derivatives, cyclophane moieties and their derivatives, chiral moieties, and polymeric moieties.